BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images may include (but are not limited to):

- BLACK BORDERS
- TEXT CUT OFF AT TOP, BOTTOM OR SIDES
- FADED TEXT
- ILLEGIBLE TEXT
- SKEWED/SLANTED IMAGES
- COLORED PHOTOS
- BLACK OR VERY BLACK AND WHITE DARK PHOTOS
- GRAY SCALE DOCUMENTS

IMAGES ARE BEST AVAILABLE COPY.

As rescanning documents *will not* correct images, please do not report the images to the Image Problem Mailbox.

PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : **A47L 9/16**	**A1**	**(11) International Publication Number:** **WO 96/19937** **(43) International Publication Date:** 4 July 1996 (04.07.96)

(21) International Application Number: PCT/GB95/03041

(22) International Filing Date: 27 December 1995 (27.12.95)

(30) Priority Data:
9426287.0 28 December 1994 (28.12.94) GB

(71) Applicant *(for all designated States except US)*: NOTETRY LIMITED [GB/GB]; Sycamore House, Bathford, Bath BA1 7RS (GB).

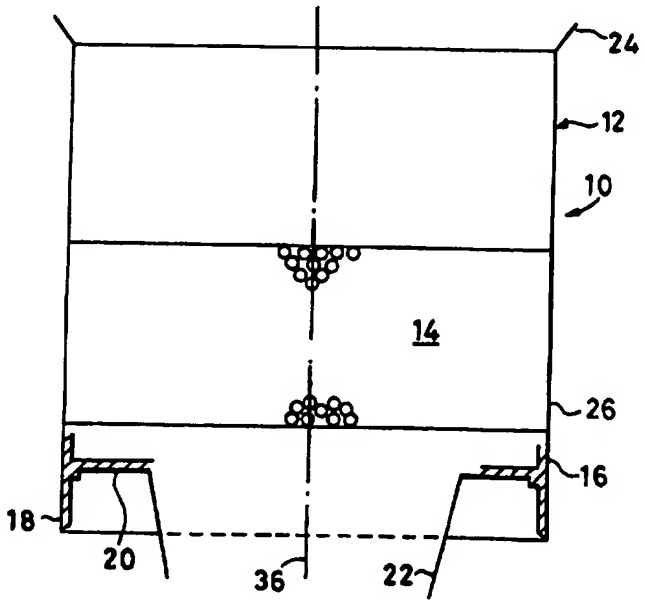
(72) Inventor; and
(75) Inventor/Applicant *(for US only)*: DYSON, James [GB/GB]; Sycamore House, Bathford, Bath BA1 7RS (GB).

(74) Agent: SMITH, Gillian, Ruth; Marks & Clerk, 57-60 Lincoln's Inn Fields, London WC2A 3LS (GB).

(81) Designated States: AL, AM, AT, AU, AZ, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IS, JP, KE, KG, KP, KR, KZ, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TT, UA, UG, US, UZ, VN, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG), ARIPO patent (KE, LS, MW, SD, SZ, UG).

Published
With international search report.

(54) Title: SHROUD AND CYCLONIC CLEANING APPARATUS INCORPORATING SAME



(57) Abstract

The invention provides a shroud (10; 40) for use in apparatus incorporating cyclonic dust separation means for separating dirt and dust from an airflow, the shroud (10; 40) comprising a perforated portion (14; 44) having a multiplicity of perforations (30; 46) for allowing the airflow to pass therethrough. According to the invention, the upstream edge of each perforation (30) meets the upstream surface (28) of the shroud (10) at a sharply defined angle. The invention improves the performance of the dust separation apparatus in conjunction with which the shroud (10; 40) is utilised.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AM	Armenia	**GB**	United Kingdom	**MW**	Malawi
AT	Austria	**GE**	Georgia	**MX**	Mexico
AU	Australia	**GN**	Guinea	**NE**	Niger
BB	Barbados	**GR**	Greece	**NL**	Netherlands
BE	Belgium	**HU**	Hungary	**NO**	Norway
BF	Burkina Faso	**IE**	Ireland	**NZ**	New Zealand
BG	Bulgaria	**IT**	Italy	**PL**	Poland
BJ	Benin	**JP**	Japan	**PT**	Portugal
BR	Brazil	**KE**	Kenya	**RO**	Romania
BY	Belarus	**KG**	Kyrgystan	**RU**	Russian Federation
CA	Canada	**KP**	Democratic People's Republic of Korea	**SD**	Sudan
CF	Central African Republic			**SE**	Sweden
CG	Congo	**KR**	Republic of Korea	**SG**	Singapore
CH	Switzerland	**KZ**	Kazakhstan	**SI**	Slovenia
CI	Côte d'Ivoire	**LI**	Liechtenstein	**SK**	Slovakia
CM	Cameroon	**LK**	Sri Lanka	**SN**	Senegal
CN	China	**LR**	Liberia	**SZ**	Swaziland
CS	Czechoslovakia	**LT**	Lithuania	**TD**	Chad
CZ	Czech Republic	**LU**	Luxembourg	**TG**	Togo
DE	Germany	**LV**	Latvia	**TJ**	Tajikistan
DK	Denmark	**MC**	Monaco	**TT**	Trinidad and Tobago
EE	Estonia	**MD**	Republic of Moldova	**UA**	Ukraine
ES	Spain	**MG**	Madagascar	**UG**	Uganda
FI	Finland	**ML**	Mali	**US**	United States of America
FR	France	**MN**	Mongolia	**UZ**	Uzbekistan
GA	Gabon	**MR**	Mauritania	**VN**	Viet Nam

SHROUD AND CYCLONIC CLEANING APPARATUS INCORPORATING SAME

The invention relates to an improved shroud and to apparatus incorporating an improved shroud.

A shroud is used in conjunction with cyclonic dust separation means to filter an airflow. In apparatus incorporating dual cyclonic separation means, ie. two separate cyclones arranged in series to remove, initially, larger pieces of dirt and fluff and, subsequently, finer dust particles, the shroud is positioned between the two cyclone arrangements and the airflow is passed through the shroud to reduce the possibility of larger pieces of dust and fluff entering the second, high efficiency cyclone.

It has been found that various features of the shroud have an effect on the overall performance of the separation means. It is therefore an object of the invention to provide a shroud which improves the overall performance of the cyclonic dust separation means in conjunction with which it is used.

The invention provides a shroud as claimed in claim 1. Advantageous and preferable features are set out in the subsidiary claims. When used in conjunction with

dual cyclonic separation means, thes arrangements improve the percentage of dirt, dust and fluff remaining in the low efficiency cyclone which, in turn, improves the performance of the high efficiency cyclone and thus of the entire separation means.

Embodiments of the invention will now be described with reference to the accompanying drawings, wherein:

Figure 1 is a side view, partially in section, of a shroud incorporating the present invention;

Figure 2a is an enlarged sectional view of part of the wall of the perforated portion of the embodiment shown in Figure 1;

Figure 2b is an enlarged detail of the embodiment shown in Figure 1;

Figure 3 is a side view of a second embodiment of the present invention; and

Figure 3a is an enlarged section through part of the wall of the perforated section of the embodiment shown in Figure 3.

Figure 1 shows a shroud 10 having a cylindrical portion 12 in which is located a perforated portion 14. The perforated portion 14 has a lower edge 16 from which depends a lip 18 which will be described in greater detail below. Extending radially inwardly from the lower edge 16 of the perforated portion 14 is an annular web 20 which communicates with or seals against an inner cyclone 22. The inner cyclone 22 forms no part of the

present invention and will not be described in any further detail here. The web 20 effectively forms support means for and a seal against the cylindrical portion 12. Further support and sealing means 24 are located at the upper edge of the cylindrical portion 12 but which, again, do not form part of the present invention, except to support the cylindrical portion 12.

Figure 2a shows, in sectional view, a portion of the wall 26 forming the perforated portion 14. The wall 26 has an upstream surface 28 and a multiplicity of perforations 30 through which, in use, the airflow passes in the direction of arrows 32. In prior art shrouds, the perforations have been formed in such a manner that the upstream edge of each perforation incorporates a radius at its intersection with the upstream surface of the shroud. According to the present invention, the upstream edge of each perforation 30 meets the upstream surface 28 at a sharply defined angle. Such an angle can be produced by forming the perforations 30 by drilling or, if desired, by moulding or any other suitable manufacturing process. The provision of a sharp angle at the intersection between the upstream edge of each perforation 30 and the upstream surface 28 of the shroud 10 decreases the amount of fine dust passing through the perforations 30 and therefore decreases the risk of the perforations 30 becoming blocked by dust and fluff particles.

The thickn ss of the material t forming the wall 26 is substantially 2mm. The diameter d of each cylindrical perforation 30 is substantially 2.2mm.

The embodiment shown in Figure 1 includes a lip 18 depending from the lower edge 16 of the perforated portion 14. The lip 18, which is shown in more detail in Figure 2b, essentially comprises a parallel sided portion 34 extending substantially parallel to the longitudinal axis 36 of the shroud 10. The distal end of the parallel-sided portion 34 is inclined at an angle α of substantially 45°. At the proximal end of the lip 18, a step 38 is formed, the breadth b of the step 38 being substantially the same as the breadth B of the parallel-sided portion 34. Both the breadth b and the breadth B are, in the embodiment shown, substantially 2mm.

The height h of the step 38 corresponds substantially to the breadth b of the step 38 and, again, is approximately 2mm in this embodiment.

The distance x to which the lip 18 extends below the lower edge 16 of the perforated portion 14 is approximately 15mm.

It has been found that this shape of bottom lip 18 of the shroud 10 reduces the amount of blockage of the perforations 30 in the shroud 10 and the amount of fine dust passing through the perforations 30 when used in dual cyclonic vacuum cleaning apparatus with the shroud

10 being positioned in the airflow path between a low efficiency cyclone and a high efficiency cyclone. A relatively large proportion of dirt and dust is retained in the low efficiency cyclone and the step 38 also improves the seal between the lip 18 and the lower edge 16 of the perforated section 14.

Figure 3 illustrates a second embodiment of the invention. In Figure 3, a frusto-conical shroud 40 is illustrated having support means 42 located at the upper end thereof. A frusto-conical perforated portion 44 is located in the frusto-conical shroud 40. A multiplicity of perforations 46 are arranged in the perforated portion 44 and Figure 3a is a sectional view through part of the side wall 48 of the perforated portion 44.

As can be seen from Figure 3a, the thickness t of the material forming the side wall 48 of the shroud 40 is substantially 2mm. Also, the diameter d of each cylindrical perforation 46 is substantially 2.2mm. The longitudinal axis of each perforation 46 is substantially perpendicular to the longitudinal axis 50 of the shroud 40 and the angle at which the interior wall of each perforation meets the external surface of the side wall 48 is sharply defined.

In the embodiment shown, the angle of inclination β of the side wall 48 to the longitudinal axis 50 of the shroud 40 is substantially 12.5°. However, this angle could be varied according to the requirements of

th cyclonic dust separating apparatus and particularly to the angle of inclination of the inclined wall of the high efficiency cyclone. The angle of inclination β is preferably substantially identical to the angle of inclination of the wall of the high efficiency cyclone so that the wall 48 of the shroud 40 can be located parallel to the inclined wall of the high efficiency cyclone whilst still providing for the passage of air between the perforations and the high efficiency cyclone.

It has been found that the provision of sharply defined perforations 46 having a diameter of 2.2mm is advantageous in that the amount of fine dust passing through the shroud is reduced thus reducing the likelihood of the shroud becoming blocked by dust or fluff. The provision of a conical shroud 40 increases the volume of the area of the low efficienct cyclone in which dirt and dust is collected thus increasing the capacity of the cyclone.

It will be appreciated by a skilled reader that the invention is not limited to the embodiments illustrated above. Various modifications and alterations will be apparent to the skilled reader as falling within the scope of the invention.

CLAIMS

1. A shroud for use in apparatus incorporating cyclonic dust separating means for separating dirt and dust from an airflow, the shroud having an upstream surface and comprising a perforated portion having a multiplicity of perforations for allowing the airflow to pass therethrough, wherein the upstream edge of each perforation meets the upstream surface of the shroud at a sharply defined angle.

2. A shroud as claimed in claim 1, wherein the sharply defined angle is substantially 90°.

3. A shroud as claimed in claim 1 or 2, wherein each perforation is cylindrical and has a diameter of substantially 2.2mm.

4. A shroud as claimed in any one of the preceding claims, wherein the thickness of the perforated portion in the longitudinal direction of the perforations is substantially 2mm.

5. A shroud as claimed in any one of the preceding claims, wherein the perforated portion is cylindrical.

6. A shroud as claimed in any one of the preceding

claims, wherein the shroud further comprises a lip depending from a lower edge of the perforated portion.

7. A shroud as claimed in claim 6, wherein the lip comprises a parallel-sided portion having an inclined distal end.

8. A shroud as claimed in claim 7, wherein the distal end is inclined at an angle of substantially 45° to the parallel sides of the lip.

9. A shroud as claimed in claim 7 or 8, wherein the parallel sides of the lip extend substantially parallel to the longitudinal axis of the shroud.

10. A shroud as claimed in any one of claims 7 to 9, wherein the lip extends between 10mm and 20mm below the lower edge of the perforated portion.

11. A shroud as claimed in claim 10, wherein the lip extends substantially 15mm below the lower edge of the perforated portion.

12. A shroud as claimed in any one of claims 7 to 11, wherein the lip is broader in cross-section at its proximal end than at its distal end.

13. A shroud as claimed in claim 12, wherein the lip comprises a step formed radially inwardly of the parallel-sided portion at the proximal end thereof.

14. A shroud as claimed in claim 13, wherein the breadth of the step is substantially equal to the breadth of the parallel-sided portion.

15. A shroud as claimed in claim 13 or 14, wherein the height of the step is substantially equal to the breadth thereof.

16. A shroud for use in apparatus incorporating cyclonic dust separation means for separating dirt and dust from an airflow, substantially as hereinbefore described with reference to any one of the embodiments shown in the accompanying drawings.

17. Apparatus for separating dirt and dust from an airflow comprising cyclonic dust separation means and a shroud according to any one of the preceding claims.

18. Apparatus as claimed in claim 17, wherein the cyclonic dust separation means comprise a low efficiency cyclone and a high efficiency cyclone positioned downstream of the low efficiency cyclone, the shroud being positioned betwe n the two cyclones.

19. Apparatus as claimed in claim 17 or 18, wherein the apparatus consists of a vacuum cleaner.

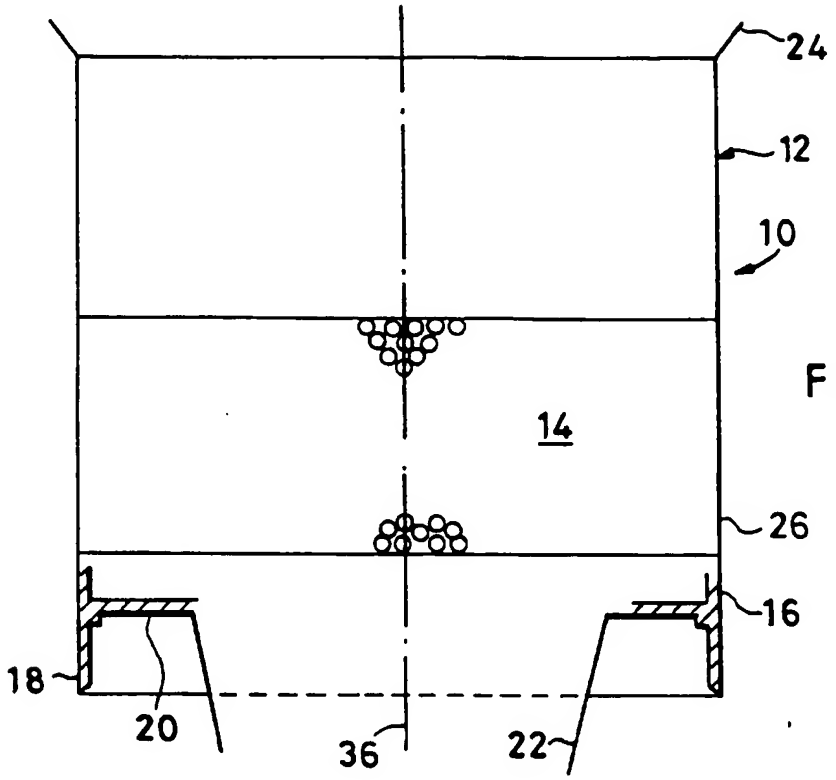


FIG.1

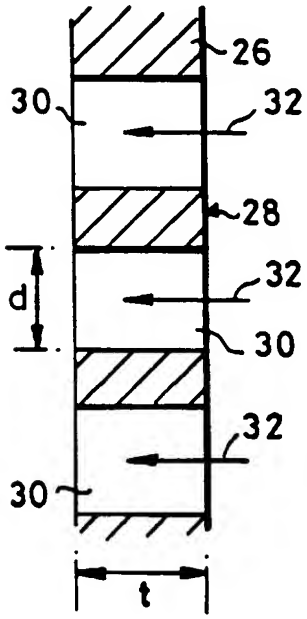


FIG.2a

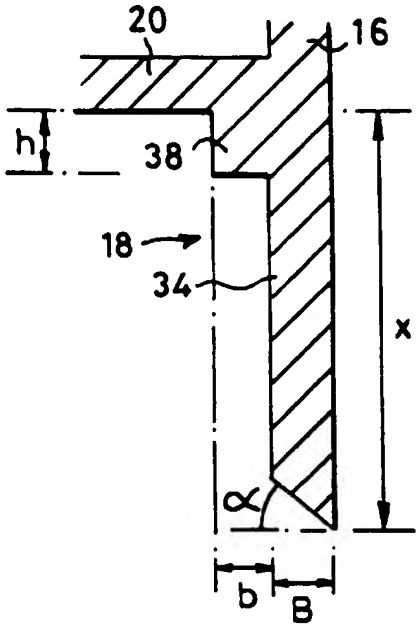


FIG.2b

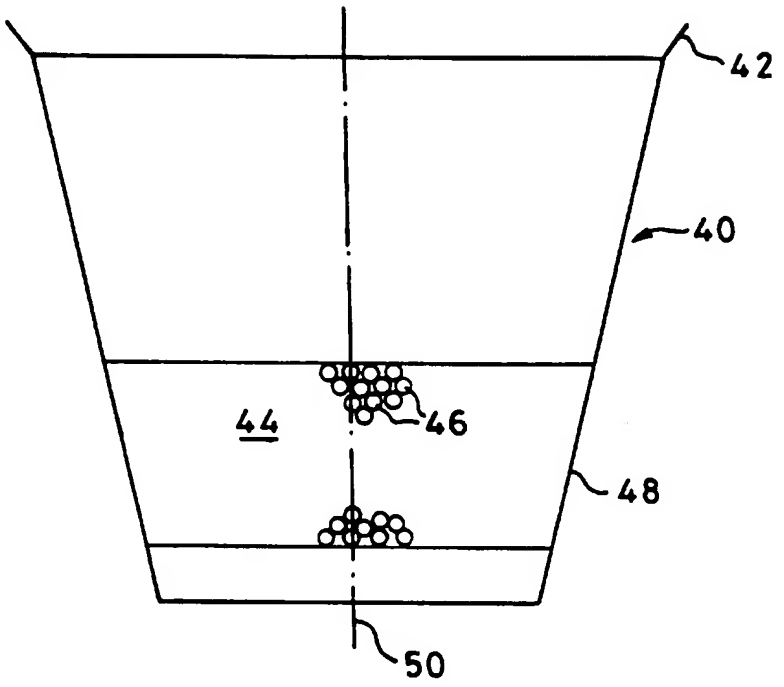


FIG.3

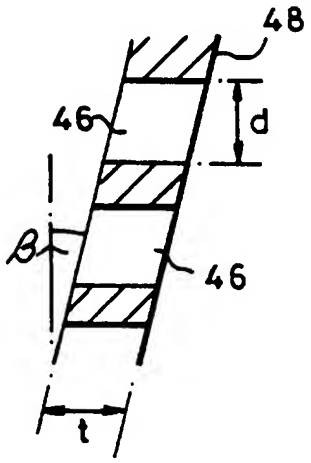


FIG.3a

INTERNATIONAL SEARCH REPORT

Inte: nal Application No
PCT/GB 95/03041

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 A47L9/16

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 A47L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP,A,0 489 565 (NOTRETY LTD) 10 June 1992 see column 11, line 13 - column 12, line 39; figure 2C ---	1-5, 16-19
P,X	EP,A,0 636 338 (NOTETRY LTD) 1 February 1995 see column 11, line 53 - column 13, line 24; figure 2C ---	1-5, 16-19
A	US,A,5 062 870 (J. DYSON) 5 November 1991 see column 5, line 47 - column 6, line 2; figure 2 2A ---	1-5, 16-19
A	US,A,4 853 008 (J. DYSON) 1 August 1989 see column 3, line 22 - line 65; figure 2 --- -/--	1-5, 16-19

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

1

Date of the actual completion of the international search	Date of mailing of the international search report
12 March 1996	21.03.95

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+ 31-70) 340-2040, Tx. 31 651 epo nl, Fax (+ 31-70) 340-3016	Vanmol, M

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Interr ual Application No
PCT/GB 95/03041

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP,A,0 557 096 (IONA APPLIANCSE INC) 25 August 1993 see column 6, line 50 - column 7, line 26; figures 4,6 -----	1-5, 16-19

1

Form PCT/ISA/210 (continuation of second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Inter ...al Application No
PC1/GB 95/03041

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
EP-A-489565	10-06-92	US-A-	5078761	07-01-92
		AT-T-	123639	15-06-95
		AU-B-	637272	20-05-93
		AU-B-	8819491	11-06-92
		CA-A,C	2056161	04-06-92
		DE-D-	69110424	20-07-95
		DE-T-	69110424	01-02-96
		EP-A-	0636338	01-02-95
		JP-A-	5176871	20-07-93
		JP-B-	6085753	02-11-94
EP-A-636338	01-02-95	US-A-	5078761	07-01-92
		AT-T-	123639	15-06-95
		AU-B-	637272	20-05-93
		AU-B-	8819491	11-06-92
		CA-A,C	2056161	04-06-92
		DE-D-	69110424	20-07-95
		DE-T-	69110424	01-02-96
		EP-A-	0489565	10-06-92
		JP-A-	5176871	20-07-93
		JP-B-	6085753	02-11-94
US-A-5062870	05-11-91	US-A-	5078761	07-01-92
US-A-4853008	01-08-89	AU-B-	610745	23-05-91
		AU-B-	3903089	01-03-90
EP-A-557096	25-08-93	CA-A-	2061469	20-08-93
		AU-B-	3307193	26-08-93
		JP-A-	6054778	01-03-94
		US-A-	5267371	07-12-93